Chemical Resistance of Borate Glasses Associated with the Radiative and Thermoradiative Coloration

A.N. Salakhitdinov and Sh.N. Nizamov
Samarkand State University
703004 Samarkand
University blvd 15
Samarkand, Uzbekistan

Chemical resistance of two - component ($K_2O.B_2O_3$) and three - component ($K_2O.Al_2O_3.B_2O_3$) borate glasses were defined on the basis of degree of solubility or alkali resistance by the method of mass loss. The sensitivity of the method, as demostrated in our experiments, depends on sample shape standardization, volume of reagent, sequence of measurement, and stability of temperature. The improvement of the setup for mass loss measurement has provided the possibility to optimize the conditions for measurements and preparation of samples. For maximum sensitivity the samples require a polished surface $0.25 \leq S \leq 0.5$ sm^2 ,with an initial mass $1 \geq m_0 \geq 0.5$ g, and with a definite geometrical (prismatic) shape. The optimum volume of reagent is 50 - 100 cm^3.

Correlating our results obtained earlier [1-2], on the radiative - optical and properties of alkali - borate and potassium - aluminium - borate (PAB) glasses (without/with addition of CuO, Fe_2O_3, S) with experimental data on the chemical resistance of these glasses we were able to correlate the radiative-optical stability and the sensitivity of these glasses with their chemical resistance.

The results of an analysis of the experimental data complex for these borate glasses exposed to external thermal, radiative and thermo-radiative treatments support the following conclusions:

1. Water-, alkali-, and acid- stability of PAB glasses γ- irradiated by doses 10^6 - 10^7R (without additions) are affected due to the increase of radiation-induced coloration, centered in region ~550 m. Improvement in the chemical stability was conditioned by radiative ignition at doses $\geq 10^8$R.

2. The concentration and dose dependence of the relative mass loss on the solubility time in heated (353 K) water for PAB - 55 and PAB - 70 glasses (with the addition of Fe_2O_3 up to 3 mass %) have a periodic character. The "period" of this solubility coincides with that for EPR-signal intensity change, which belong to radiation-induced paramagnetic centres [Fe^{3+}] with $g \approx 2{,}007$.

3. For alkali-borate ($K_2O.B_2O_3$) and ($Na_2O.B_2O_3$) glasses without/with CuO (up to 1 mass%) additions, the remelting of glass in a γ-field (^{60}CO) of power $\geq 10^3$ $^R/_c$ (thermo-radiative ignition) leads to the improvement of water- and acid stability. These changes (observed by optical and EPR spectroscopy) are bound with structure modification, namely, with radiation stimulated an increase in density with the ignition of induced defects.

4. By the thermo - ignition method for glass subjected to irradiation by ^{60}Co γ - beams, it was showed that their radiative - chemical properties are related to radiative induced color centers. It is suggested that the solubility rate for important industry glasses are available and can be controlled by laser UV - irradiation.

Results of this work can be used for the production of prolonged action fertilizer with necessary microelements.

1. A.N. Salakhitdinov, A.H. Babaev, and D. R. Umarova et al., *Fan* (1992).
2. A.N. Salakhitdinov, 9 - 11 October, State University of Karaganda, Kasakhstan, 25.